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Impacting Online Classes With Augmented Reality Based Education

D.Roopa[1] , Dr.S.Bose[2]

[1]Assistant Professor, Sri Sai Ram Institute of Technology, Chennai

[2]Associate Professor, Anna University, Chennai virtual/real information. Augmented immersive reality (AIR)

Abstract - Covid-19 pandemic affects our life suddenly and dramatically. The most affected area was our teaching methods. Students and teachers move to distant learning without good experience and background especially for non-IT teachers. Technology enhanced learning has attracted increasing attention of educational community focused on improvement of traditional classroom learning/online classes. Augmented Reality(AR) technology enhances user's perception of reality by augmenting computer- generated components and reinforcing the retention of critical knowledge that may otherwise widen student knowledge gaps. AR in education can conceivably impact the student participation, information transfer and skill acquisition, hands on digital experience with the education when there is no practical exposure to laboratories.

Keywords- Immersive AR, Interactive Education, Image Tracking, Image Recognition

I. INTRODUCTION

Augmented reality offers a live, direct or indirect view of a physical, real-world environment whose elements are augmented by computer-generated components such as audio, video, 2/3-D graphics, GPS data, etc. Unlike virtual reality that simulates a virtual environment to replace the real one and completely immerses users inside the synthetic environment, AR supplements the surrounding real world by augmenting it with virtual, computer-generated overlay added to the physical environment through a auxiliary sensory mechanism and allowing users to see the real world with virtual objects superimposed on the real world. AR applications generate and enable a common space where virtual and real objects coexist in a seamless way, and enhance user's perception of reality by providing them with an interactive environment and digitally manipulated lies between the AR and the physical environment and offers more enhanced experience with the examined reality through the artificial components added or blended into the scene to improve its perception. It has been shown that AR technologies can help to increase learning motivation of students and enhance the quality of learning experience[2].

The adaptive technological solutions for education have been increasingly popular. Education can be

rather flexible when it concerns the methods of increasing student engagement and interest in learning. Online courses, chat bots, gamification, and, of course, virtual and augmented reality – today you can find all of them in the curricula of both primary schools and universities. The proposed system consists of a set of components centered on the mobile phone to exploit its sensory and data processing capabilities. The AR technology is enabled through the interaction of a set of predesigned cards with chemical substances or element structures printed on and the AR smart phone application that visually senses the real world with the camera and live augmenting the perceived view with the virtual objects. The mobile application has been developed using Unity engine and Vuforia AR SDK and can run across multiple platforms like IOS, Android, WebGL etc.

The main objective of this work is Quality Education and Reduced Inequalities by improving the standards of education especially online classes using the cut-edge technology called Augmented Reality[3]. Augmented reality can help make classes more interactive and allow learners to focus more on practice instead of just theory thus increasing the student's productivity.

II. RELATED WORK

J. Martín-Gutiérrez et el [8] proposed the work to measure the learning motivation of undergraduate health science students at the University of Cape Town (UCT) before and

after using a particular AR mobile application. The main research issue was the differences in student learning motivation before and after using the AR mobile application. The main research question was underpinned by several sub questions examining how the attention, relevance, confidence, and satisfaction aspects of learning motivation were affected by using the AR mobile application. **D. A.**

Budiman et el [6] AR no longer requires specialized equipment and may easily be used through computers or mobile devices. A lightly AR supplements the real world with a relatively small amount of virtual information, while a heavily AR contains frequently accessible virtual information. The amount of virtuality within the real world determines the type of technology required to support the AR, as different display and tracking technologies result in different degrees of immersion. Immersive technologies such as head-mounted displays are used to support heavily AR and foster more immersion than mobile devices, which can support lightly AR. An example of a lightly AR would be the Pokémon GO mobile application, which can be used through a Smartphone. An example of a heavily AR is the Star Wars Jedi Challenges mobile application which requires the user to use a headset. Many people now own mobile devices and therefore have access to AR. The use of AR for learning has been made more feasible due to advances in mobile technology and the increased use of smart phones. Smartphone and tablets are ideal to facilitate AR experiences, due to fast processors, graphics hardware, and various onboard sensors[5].

The educational value of AR is closely linked to the way in which it is designed, implemented, and integrated into formal and informal learning environments. An important consideration is how AR technologies support and afford meaningful learning. Considering AR as a concept rather than a certain type of technology would be productive for educators. The involvement of educators is important to

facilitate the development of favorable AR applications. Some of these AR applications have been used in previous studies. **Gopalan et al.[4]** tested the impact of AR enhanced science textbooks on lower secondary school students in Malaysia. **Chiang et al**. [10] tested the use of an AR based mobile learning system for natural science inquiry activities on fourth-grade students in Taiwan. The system guided students towards target ecology areas and displayed the corresponding learning tasks or related learning materials. Akçayır et al. tested the use of an AR enhanced laboratory manual in science laboratories on first-year students in Turkey. This study tested the impact of the Anatomy 4D mobile application on the learning motivation of health science.

M. Sirakaya et el [3] proposed the idea aimed to identify the trends in the studies conducted on Educational Augmented Reality (AR). Analyses displayed that the number of educational AR studies has increased over the years. Quantitative methods were mostly preferred in those articles and educational AR was often found to be used in science education (physics, chemistry and biology), engineering education and medical training. The reviewed articles showed that "undergraduate students" were used as samples for most of the time, the most often preferred sample size was between "31-100" and "surveys" were the most utilized data collection tools. While the majority of the articles used marker-based AR as AR type, mobile devices were utilized in many of these articles as the delivery technology.

Kuang, Y., &Bai, [1] Some very intuitive, interesting things, life experience can be naturally recorded in the mind of children, and for children in the preschool stage, the way of image memory occupies a very large proportion, the ability level of memory words has gradually developed. Children in this age group have an unintended memory advantage, but intentional memory increases gradually as they grow. Their group has the following three typical memory development characteristics: (1) with the brain easy to excite, but also very unstable: (2) The performance is easy to remember, but also easy to be forgotten. (3) The accuracy and consolidation of memory is poor. It is according to the characteristics of children's psychological development, the application of augmented reality in the field of early childhood education covers the "multi-modal visualization of theoretical concepts and traditional multimedia textbook interaction Theory and practical exploration" and so on, by fitting the characteristics of children's psychological development, can make the APP better and effectively enhance the process of young children learners to explore, discover the knowledge. Individual with self-motivation always can find a motive and intensity without expecting external encouragements to complete a task even though the task is challenging. In contrast, negative motivation illustrates the behavior is motivated by expectation and fear of not able to achieve the aimed outcome. Fear considered as a powerful motivator, notably when the fear is regarding our survival and future Endeavour's [14].

v. **Gopalanet et el.,** [4] There are several motivation theories for instance the instinct theory which is considered as the root for all the motivation and motivation is to survive. The theory depicts that biological or genetic programming causes the motivation to occur and all human beings share the same motivation as all of us are sharing the similar biological programming . Then, the incentive theory is among the major theories of motivation. This theory illustrates the desire to motivate behaviors for enrichment or incentives , which means we are motivated to perform actions because of internal desires and desires, yet at other times, our behaviors are passionate by a desire for external rewards.

Besides that, the arousal theory illustrates the maximum level of eagerness or arousal. People with high optimum levels of arousal will perform high enthusiastic behaviors, like bungee jumping, scuba diving and so on. While the rest of us are feeling contented with less exciting and less unsafe activities. The theory depicts the ability to do what needs to be done, without influence from others or circumstances.

III. SYSTEM ANALYSIS

a. Existing System

In existing system, the user should create some images with characteristic patterns. He should also prepare some virtual models, described in VRML format. These models are later associated to the corresponding characteristic patterns, The camera supplies the frames to an application which searches the current frame for known patterns, which are stored in a database of registered patterns[9]. If a match is found the software displays the virtual object attached to the found marker. Our entire system is based on recognition of fiducial rnarkers. Fiducial markers are selected points on an image that are used as a frame of reference in locating objects. Our application (based on the ARToolKit library) then searches each frame for registered pattems and displays virtual objects associated with them. If we move in the real world the real objects signed with fiducial markers the same movements, translation or rotation in the space, will be made on the associated virtual objects. This means that we could put fiducial markers on Here, the real objects that are visualized on the screen and on these objects could be superimposed additional artificial or even abstract objects that will give a deeper explanation of some presented phenomena but no interactions.

- In this system, the captured image or video frame is matched with pre-stored images to know the position and the kind of virtual object that is to be blended in the view of real scene.
- As a result, an augmented image appears on the device (i.e) only the 3D view of the image is be displayed.
- Existing System has problems with sensitivity trigger

In existing system architecture it is seen that images have been collected using cameras and sensors in many fields. The image processing (recognition and tracking) methods have been applied on the collected images and this data has been used in augmented reality. In this study, an image processing-based module has been developed for augmented reality devices[7]. It is aimed to improve visual quality by using the developed module on the augmented reality devices. The existing system architecture is shown in the figure 1.

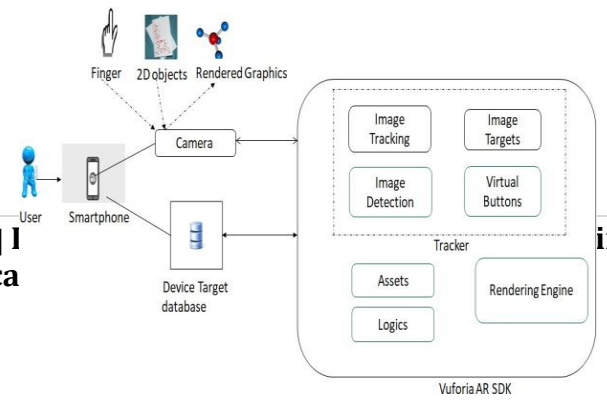

Figure. 1 Existing System Architecture Limitations

- Non-interactive models
- Extremely costly when using AR HMD's
- People with hearing aids find it difficult to understand the non interactive models

b. Proposed System

The proposed aims to improve teaching quality in education via interactions and other components using augmented reality with Unity and Vuforia. Feature extraction and pre- processing is performed on the images using basic image processing methods. Google search feature along with audio source components have been included. Various techniques have been adapted to ensure the user interactivity with the 3d objects.

Proposed System Architecture

In the proposed system, Interactive 3D Experience for inquiry based learning for abstract concepts, Promoting experimental learning through which students can perform lab procedures with event-action sets(using c# in Unity). External links to know more information (Google and YouTube). Thus gives an immersive experience. The event action sets are simulated using C# in the Unity Platform. Vuforia Database stores the target images, developer should ensure that the image rating is 4 and above so that the feature points in it are correctly read and recognized by the image processing algorithm. Ray casting technique was used to for the touch detection on the 3D Models this written code works well in desktop system and Mobile phones. Thus our proposed system seems much better and appealing then the existing one with the various techniques adopted.

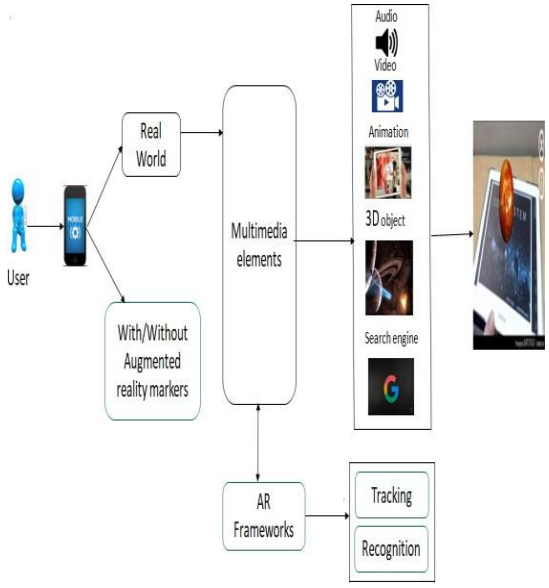

Figure. 2 Proposed System Architecture Main benefits are

- Inexpensive for the users.
- Children with hearing aids get clear foot prints of the study concepts.
- Can be used in any smart phone with Android version of 6+.

IV. SYSTEM DESIGN

This chapter describes the design phase of a work which is divided into following 4 modules

1. Integration of Platforms
2. Scene Navigation
3. Scene Development
4. Audio, Google Redirection.

It briefs about system design of each module along with its functionalities. The entire process flow and its interaction with the system components are explained.

ntegration Of Platforms

Module involves the installation of Unity 3d engine, Java JDK, Android Studio, Microsoft Visual Studio and Blender (for modify/edit/create of 3D Models). The next step involves the integration of everything inside Unity 3d. Prerequisites include creating a Vuforia Developer account, creating a Database in it for storing the image targets and then generating a license to build our project.

Steps For Integration Of Platforms

Step 1: Install the above specified applications in the system.
Step 2 : Inside Unity Player settings from Edit > Project Settings, then select the Player category, and select the tab for the mobile device you are building to. Under the XR Settings panel, enable the Vuforia Augmented Reality Support property.
Step 3: Go to File -> Build Settings -> Android and click Switch Platform.
Import or open the project you have just created with Unity Enable Google Android Project. Click Export.
Step 4: In Unity, go to Edit > Preferences, and make sure that Visual Studio is selected as your preferred external editor. Next, double click a C# file in your project. Visual Studio should automatically open that file for you. You can edit the file, save, and switch back to Unity to test your changes
Step 5: Store newly generated solutions. In Unity, go to Edit > Preferences, and make sure that Visual Studio is selected as your preferred external editor. Next, double click a C# file in your project. Visual Studio should automatically open that file for you. You can edit the file, save, and switch back to Unity to test your changes

b. Scene Navigation

The Scene view has a set of navigation controls to help you move around quickly and efficiently. They are Scene Gizmo, Move, Orbit and Zoom tools and the Center too price displayed. The data flow diagram for Scene Navigation is shown in the below Figure 3

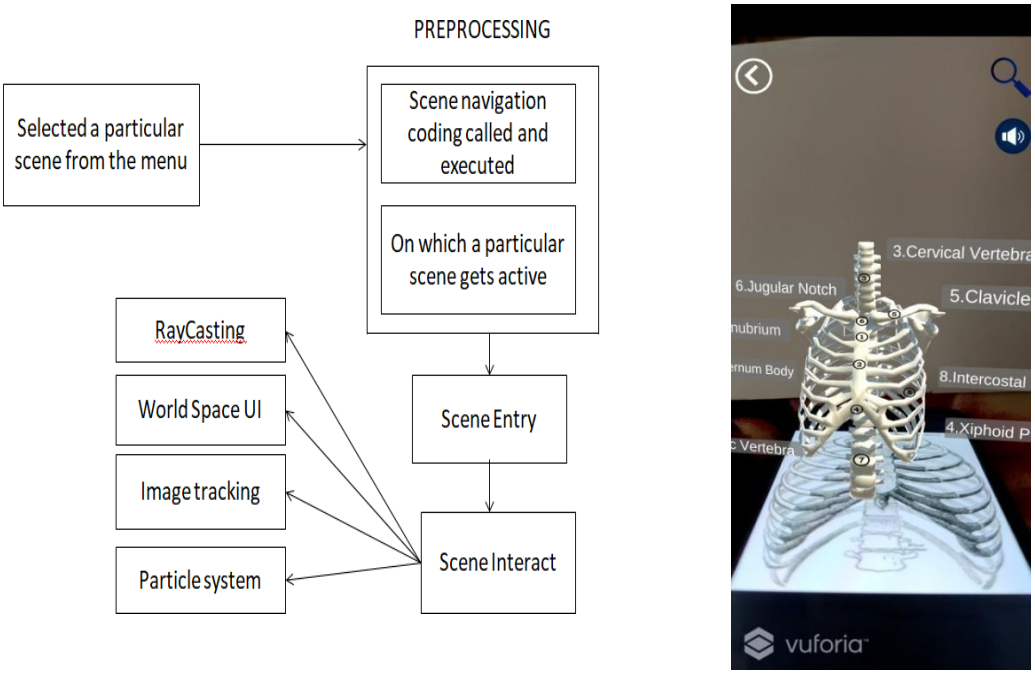

Figure 3 Data Flow Diagram for Scene Navigation

c. Scene Development

Scene Navigation is mainly used to switch between the multiple scenes in our application such as Home, Geography, 7 Wonders of the world, Biology, Chemistry and Flame Test. Scenes contain the objects of your game. They can be used to create a main menu, individual levels, and anything else. Think of each unique Scene file as a unique level. In each Scene, you will place your environments, obstacles, and decorations, essentially designing and building your game in pieces. Fig 4.a,b,c shows the Augmented Reality view for Geographic scene generated, Ribcage view and Chemistry Scene complex Structure for the marker respectively .

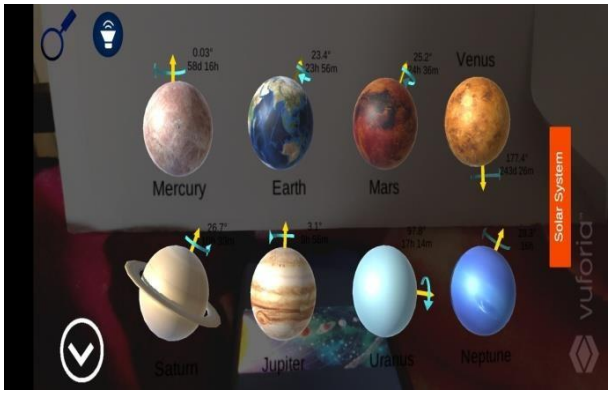

Fig.4.a Geography Scene

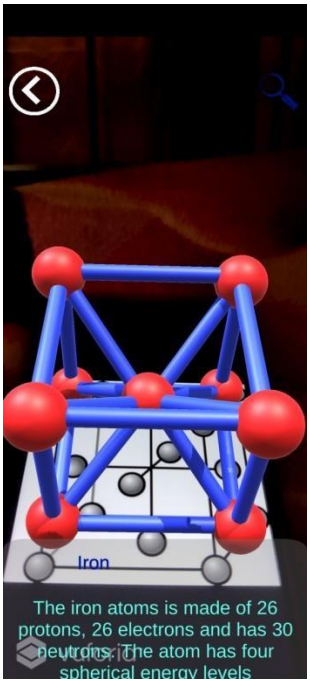

Fig.4.b RibGage Scene

Fig .4.c Chemistry scene Complex Structure

Steps Involved In Developing a Scene:

Step 1: To open a scene, in order to begin or continue working within that scene, double-click the scene asset in the Project Window. If your current scene contains unsaved changes, you will be prompted to save or discard the changes.

Step 2: Depending on what kind of object you want to create, you add different combinations of components to a Game Object. You can think of a Game Object as an empty cooking pot and components as different ingredients that make up your recipe of game play. Unity has lots of different built-in component types.

Step 3: You can create a prefab by selecting Asset > Create Prefab and then dragging an object from the scene onto the "empty" prefab asset that appears. If you then drag a different Game Object onto the prefab you will be asked if you want to replace your current game object with the new one.

Step 4: Write scripts in Unity in C#, a powerful object- oriented programming language. Create variables that can be changed in the editor. Detect player input and react to it. Use physics to create interactions

Step 5: Build, test and deploy.

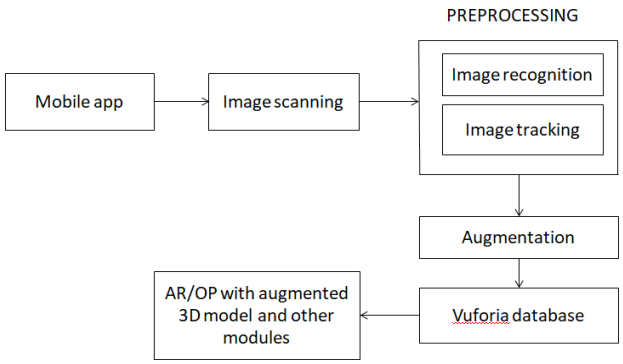

Fig 5 Data Flow Diagram for Scene Development

The data flow diagram Advanced vehicular technology is shown in the below Figure 5.

V. PERFORMANCE

Programs Good performance is critical to the success of many games. Below are some simple guidelines for maximizing the speed of your game's rendering. The graphical parts of your game can primarily impact on two systems of the computer: the GPU and the CPU. The first rule of any optimization is to find where the performance problem is, because strategies for optimizing for GPU vs. CPU are quite different (and can even be opposite - for example, it's quite common to make the GPU do more work while optimizing for CPU, and vice versa). Fig 6 Illustrates the view for flame test generated in Chemistry lab for various chemical reaction

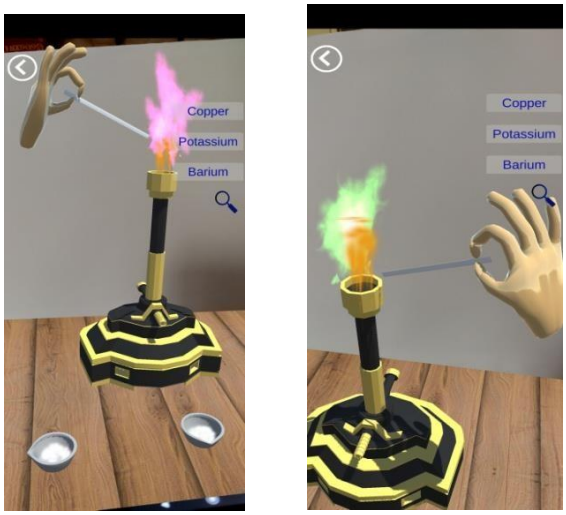

Fig 6 Flame Test with chemicals

a. Image Tracking

- Static Device Tracker**::** This is ideal for applications where the device will remain static, like on a tripod or an overhead camera on a workbench. There is no need for the device to first be in motion for tracking to start. Perfect for toys, books, or even maintenance scenarios that require the use of both hands. Vuforia Engine offers robust and accurate tracking by using the Positional Device Tracker that includes tracking a Vuforia target even when the object or content is no longer in the camera view. Note that some Vuforia features are required to run on a Device Tracking supported device.
- Positional Device Tracker – Learn more on the API behind this capability.
- Tracking state API results – With the device tracker comes the tracking states that you can use to optimize the experience to your user's needs.

Continued AR Experiences – Learn more on using the states to resume from interrupted and paused AR sessions.

b. Status In Object Target Result

The status information provided on Image Target, Object Target Results are identical. The following table 1.1 lists the available tracking state values:

STATUS	DESCRIPTION
DETECTED	This is a transient state and not observable in most cases.
TRACKED	The trackable is being tracked and indicates normal operation.
EXTENDED_TRACKED	The trackable is not directly tracked with the specific tracker. It is either out-of-view, too- far or too-close to be tracked directly

LIMITED	he trackable is being tracked but only with very low accuracy. If your application requires exact target alignment, it is recommended to discard LIMITED poses of targets

Table 1.1 Available tracking state values

c. Image Recognition

Vuforia first detects "feature points" in your target image [Web-based target management] and then uses the data to compare the features in target image and the receiving frame from camera. Vuforia uses edge-detection technique. If there are more vertices or lines in the high-contrast image then its a high rated image for Vuforia. So, we can say that their algorithm is somewhat similar to SIFT. Image Recognition can be used to build rich and interactive experiences with 3D objects. These experiences could be augmenting a toy with 3D content in order to bring it to life, overlaying a user manual on top of a consumer electronics device or leading a new employee through an interactive training process for a workplace device. Another simple application of Object Recognition is to unlock new in app content when a product is recognized

VI. CONCLUSION AND FUTURE ENHANCEMENT

It was very clear that AR can support teaching and learning, especially with distant learning methods. AR reduces cognitive load to a much larger extent. The real challenge of AR Application lies in the usability in terms of technical experience and technical problem solving. However, it enables the distant learning process to be easier for learners in terms of interaction with their environment as well as in contacting face to face with the people around them. Future enhancements include the usage of the Head mounted display devices to accelerate the immersive experience especially to develop modules for engineer trainees in manufacturing sectors. Teachers now have a powerful tool called Augmented Reality. AR can motivate and engage students making the STEM Coding learning process faster, fun and better than ever before.

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